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Environmental Management Division
Environmental Control Services

Environmental Control Programs

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SOURCE EMISSION TESTING FOR SULFUR DIOXIDE AND SULFURIC ACID MIST AT CANADA METAL CO. LTD., WINNIPEG, MANITOBA. 1982

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ABSTRACT

In June 1982, a series of sub-isokinetic source emission tests were conducted on the reverberatory furnace baghouse exhaust stack of the Canada Metal Co. Ltd., Winnipeg. These tests were for information only and were not compliance tests. During normal plant operation the average sulfur dioxide gas emission rate was 87.8 kg/h while the average emission rate for sulfuric acid mist (including sulfur trioxide) was 16.2 kg/h.

The average concentration of sulfur dioxide gas in the stack gas was 4.57 g/dscm while the average sulfuric acid mist concentration (including sulfur trioxide) was 0.84 g/dscm.

INTRODUCTION

The Canada Metal Co. Ltd., 1221 St. James Street, Winnipeg, a secondary lead smelter, was a known source of sulfur emissions to the atmosphere. In June, 1982 the Environmental Management Division undertook to sample the reverberatory furnace baghouse exhaust stack for emissions of sulfur dioxide gas and sulfuric acid mist. This was in response to odour complaints from local businesses.

Lead storage batteries were being refined in the furnace to produce lead ingots weighing approximately 1450 kg. Sulfur compounds primarily in the form of sulfur dioxide and sulfur trioxide gases were being released when the battery plates were melted.

PROCESS DESCRIPTION

A reverberatory furnace is used to purify scrap lead to lead ingots. This furnace consists of a rectangular refractory lined chamber with a burner situated at one end. A large part of the heat released from the fuel, which is burned separately from the scrap, radiates directly down to the charge lying on the hearth. Coinciding with this, a substantial amount of heat radiates to the walls and arched roof of the furnace and is radiated down to the hearth. A process flow diagram is illustrated in Figure 1.

A conveyor is used to transfer scrap, mainly battery plates and lead drosses, to the furnace. The furnace is charged every 15 minutes with approximately 450 kg of scrap. Molten lead is continuously tapped from the furnace and may be further refined on site. The slag is periodically tapped off and is normally not further processed at the plant.

Exhaust gases pass through two cooling towers and are then directed to a baghouse. Dust collected by this baghouse is returned to the furnace via a screw conveyor. The exhaust gas is then released from the baghouse via a 104 cm diameter 19.8 m stack.

The rated capacity of the furnace is 22.7 tonnes of lead per day.

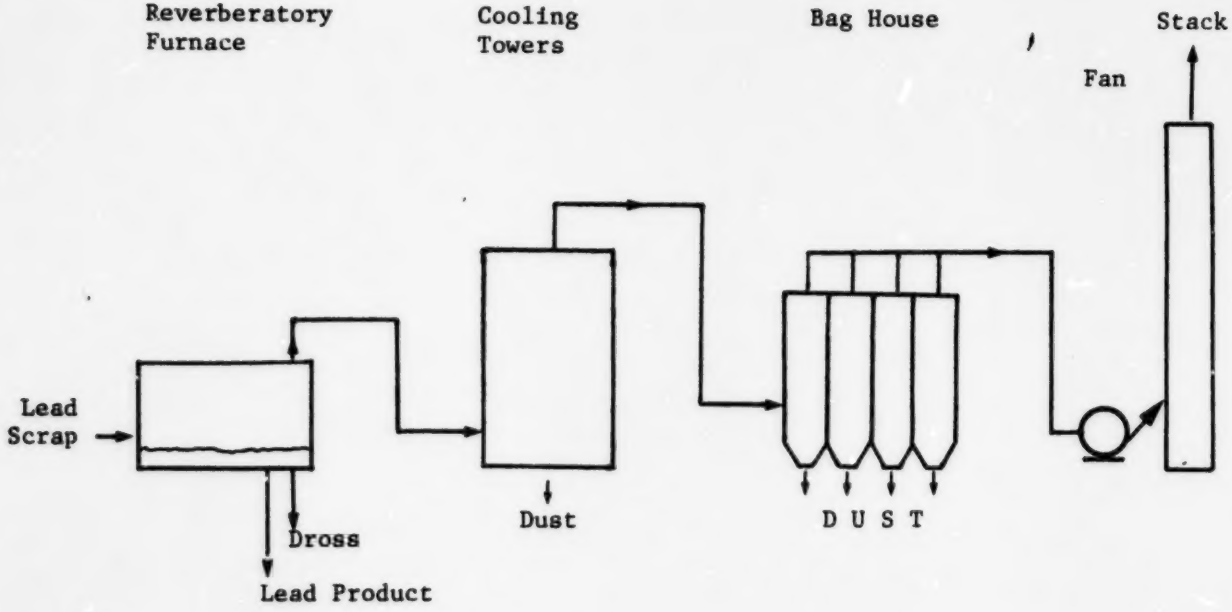

FIGURE 1. PROCESS FLOW DIAGRAM FOR A REVERBERATORY FURNACE.

TEST PROCEDURES

Testing was conducted according to Environmental Protection Agency Method 8. Figure 2 depicts the sample collection system. The sample was drawn into the nozzle, through a glass lined probe and into impinger one which was loaded with 100 ml of 80% isopropyl alcohol in deionized water. This solution was used to trap the preferentially soluble sulfuric acid mist (including sulfur trioxide). A filter was inserted before impinger two to eliminate any sulfur trioxide carryover. The second impinger, a modified type, was loaded with 100 ml of 3% Hydrogen Peroxide, as was impinger three which was of the standard design. The two peroxide solutions oxidized sulfur dioxide gas to sulfur trioxide. The last impinger was loaded with 200 g of indicating silica gel which removed moisture from the gas sample. All impingers were of 500 ml capacity.

A Bendix Series 4500 Isokinetic Stack Sampler was used to extract the samples from the baghouse exhaust stack. Gas Velocity in the stack was measured with a S type pitot tube and a Dwyer Model 2000-0 Magnehelic Differential Pressure Gauge (range 0 to 0.5 " H_2O, minor division 0.01 " H_2O). Dry gas meter and pitot tube calibration sheets are located in Appendix A. A Hays-Republic Model 621A Gas Analyzer was used to determine CO_2, O_2 and CO content of the stack gas. Stack temperature was measured by K type thermocouple.

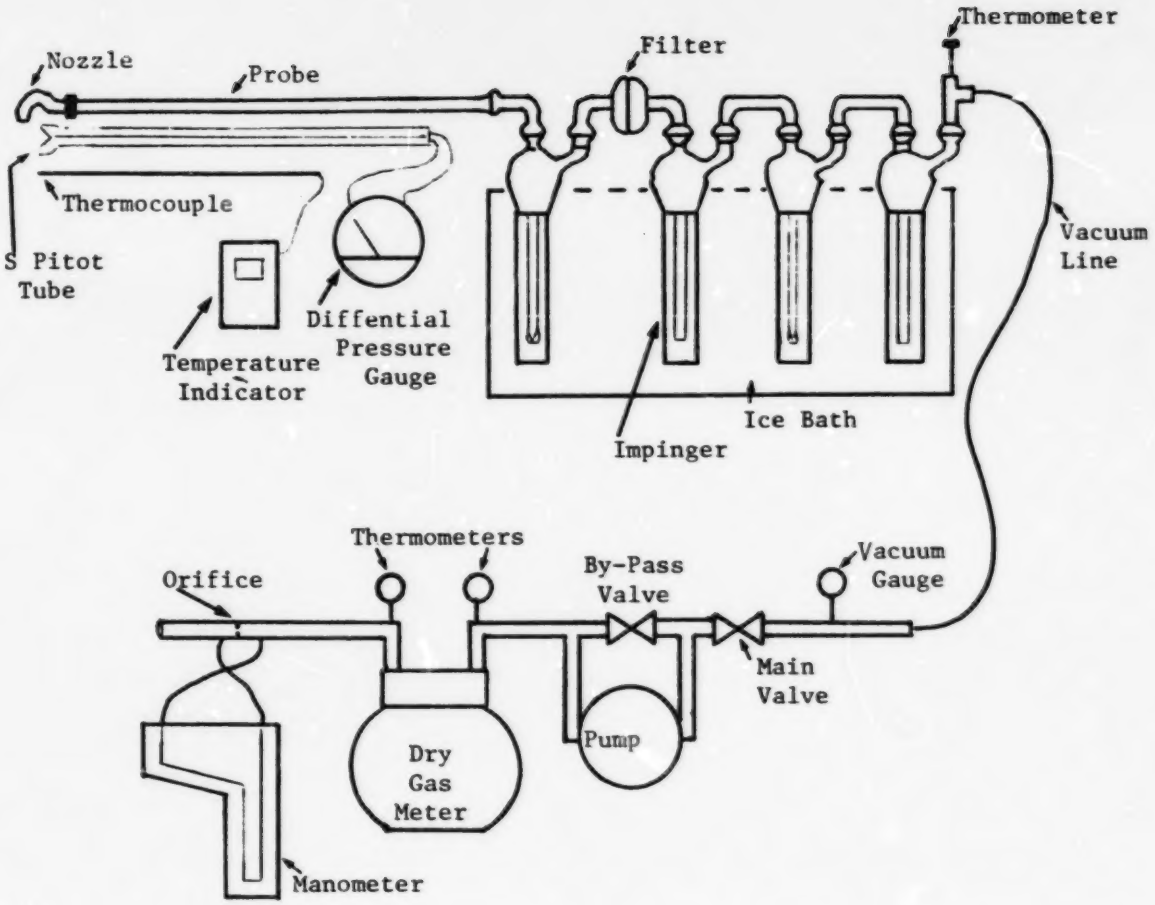

FIGURE 2. SAMPLE COLLECTION SYSTEM FOR SULFUR DIOXIDE AND SULFURIC ACID MIST.

The sampling was conducted from two ports, at right angles to each other, located 7.7 metres (7.4 stack diameters) downstream from the breaching. These ports were approximately 12 metres (11.6 stack diameters) from the top of the stack. Eight points were sampled along each traverse (a total of 16 points per test) to ensure that a representative sample was collected. The stack had a continuous inside diameter of 104 cm to approximately 2 metres above the sampling ports where it constricts slightly. The sample points located at 3.4, 11.0, 20.2, 33.6, 70.5, 84.0, 93.2 and 100.7 cm from the sampling port, are depicted on a cross section of the stack in Figure 3.

All three tests were conducted on June 1, 1982.

The sampling team consisted of Kevin Reeve, Art Schultz and Mark Steiman.

The samples were submitted to the W. M. Ward Technical Services Laboratory for analysis.

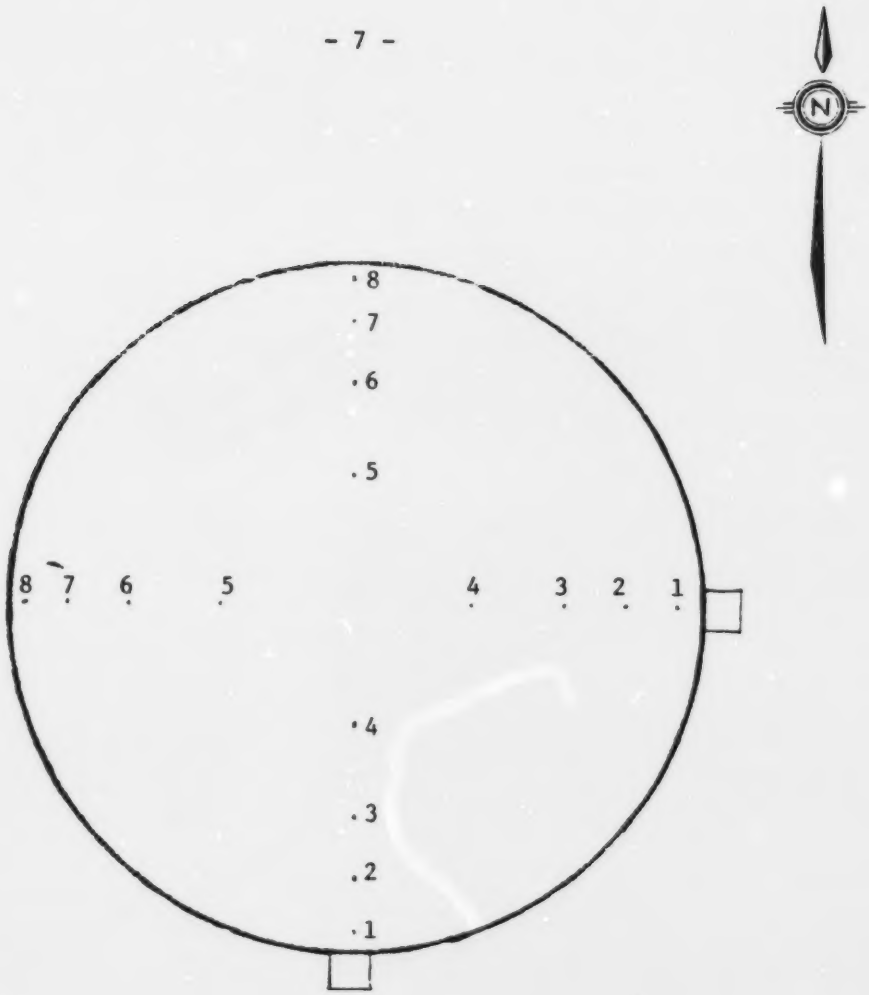

FIGURE 3. STACK CROSS SECTION SHOWING SAMPLE POINTS.

RESULTS

Stack velocity profiles, which were quite uniform throughout the testing program, are illustrated by Graphs 1 through 6 in Appendix B. Some of the more important sampling variables are summarized in Table 1. Refer to Appendix C for field data.

Source emission data is summarized in Table 2. The laboratory analysis report is located in Appendix D.

TABLE 1: SUMMARY OF SAMPLING VARIABLES

TEST NUMBER	1	2	3
SAMPLING DATE	June 1, 1982	June 1, 1982	June 1, 1982
SAMPLING DURATION	80 min.	80 min.	80 min.
SAMPLING VOLUME @ METER CONDITIONS, m^3	1.774	1.780	1.819
SAMPLING VOLUME @ STANDARD CONDITIONS,*dscm	1.732	1.714	1.749
AVERAGE GAS METER TEMPERATURE, ^oC	23	27	28
ORIFICE PRESSURE DROP, mm H_2O	48.0	47.8	50.3
STACK STATIC PRESSURE, mm H_2O	2.5	2.5	2.5
AVERAGE STACK GAS TEMPERATURE, ^oC	78	81	82
AVERAGE STACK GAS VELOCITY, m/s	8.0	7.7	8.0
ISOKINETIC FACTOR, %	80.2	84.5	83.9

*Standard Conditions are 25^oC and 760 mm Hg

TABLE 2. SOURCE EMISSION SUMMARY

TEST NUMBER		1	2	3	AVERAGE
STACK GAS COMPOSITION DRY BASIS, % BY VOLUME:	CO_2	0.8	0.8	0.8	-
	O_2	18.3	18.1	18.1	-
	CO	1.2	1.2	1.2	-
	N_2	79.7	79.9	79.9	-
STACK GAS MOISTURE % BY VOLUME		2.4	3.6	3.5	3.2
M_s**, g/g-mole		28.62	28.49	28.50	-
AVERAGE STACK GAS VOLUMETRIC FLOW RATE, dscm/h		19,746	18,788	19,237	19,257
CONCENTRATION OF SULFUR DIOXIDE IN THE STACK GAS, g/dscm		4.34	5.75	3.63	4.57
EMISSION RATE OF SULFUR DIOXIDE kg/h		85.6	107.9	69.8	87.8
CONCENTRATION OF SULFURIC ACID MIST*** IN THE STACK GAS, g/dscm		0.85	0.68	0.99	0.84
EMISSION RATE OF SULFURIC ACID MIST*** kg/h		16.9	12.8	18.9	16.2

** Molecular Weight of the Stack Gas on a Wet Basis
*** Includes Sulfur Trioxide

DISCUSSION

The average isokinetic conditions for tests one, two and three were 80.2, 84.5 and 83.9% respectively. However, this does not affect the sulfur dioxide and sulfuric acid mist emission rate and concentration calculations as gases and fine mists do not need to be sampled isokinetically.

As reported in Table 2 considerable variation exists in the emission rate and concentration of sulfur dioxide gas and sulfuric acid mist. This may be due to differences in the scrap being charged during each of the tests.

CONCLUSION

The average emission rate for sulfur dioxide gas was 87.8 kg/h while the average emission rate for sulfuric acid mist (including sulfur trioxide) was 16.2 kg/h. The average concentration of sulfur dioxide gas in the stack was 4.57 g/dscm while the average sulfuric acid mist concentration was 0.84 g/dscm.

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Gas Sampling. Stack Sampling News. 10(8); 4-6; 1982.

U.S. Environmental Protection Agency. Standards of Performance for New Stationary Sources: Revision to Reference Methods 1-8. Federal Register. 42(160); 41,754-41789; 1977

APPENDIX A: Equipment Calibration Data

APPENDIX B: Velocity Profile

APPENDIX C: Field Data Sheets

APPENDIX D. Analytical Report

APPENDIX A: EQUIPMENT CALIBRATION DATA

DRY GAS METER & ORIFICE METER CALIBRATION SHEET

Dry Gas Meter S/N 711030 (Berdin 34427) Calibrated with large wet-test meter

Average Atomospheric Pressure 29.35 in. hg or 745.5 mm. hg Ambient/Room Temperature 21 °C.

Calibrated by P & K. Reeve Date 28 Jan. 82

Manometer Orifice (ΔH)	Wet-test Meter Volume (Vw)	Dry Gas Meter Reading		Dry Gas Meter Volume (Vd)	Wet-test Meter (Tw)		Dry Gas Meter (Ti)	Dry Gas Meter (To)	Time (t)		Wet-test Manometer (Δm)	Wet-test: Dry Gas Meter Ratio (γ)	Flowrate thru' Wet-test Meter @ S.T.P. Meter (Qm)	X	Y
		Initial	Final												
in. H_2O	Ft.^{3}	Ft.^{3}	Ft.^{3}	Ft.^{3}	°F.	°C.	°F.	°F.	Min.:Sec.	Minutes	in. H_2O	-	Ft.^{3}/min.	-	-
2.05	5.0	742.659	747.779	5.120	68.5	20.28	106	86	6:14.90	6.24833	0.40	0.99867	0.80361	1.14481	
1.50	5.0	751.894	757.034	5.140	68.5	20.28	109	85	7:12.24	7.20400	0.34	0.99779	0.69658	0.97164	
1.000	5.0	758.070	763.220	5.150	68.6	20.33	109	85	9:49.90	9.83167	0.26	0.99663	0.51080	0.71928	
0.562	5.0	764.258	769.415	5.157	68.8	20.44	106	85	12:22.60	12.37667	0.20	0.99314	0.40599	0.56767	
2.53	5.0	771.476	776.645	5.169	68.8	20.44	114	87	5:39.96	5.66500	0.39	0.99518	0.88618	1.27211	
3.04	5.0	778.716	783.876	5.166	68.8	20.44	115	88	5:11.30	5.18833	0.48	0.99649	0.96835	1.39463	
4.03	5.0	785.941	791.160	5.159	68.8	20.44	116	89	4:26.96	4.44933	0.60	0.99747	1.12881	1.60557	
1.51	5.0	793.175	798.370	5.195	68.9	20.50	112	89	7:14.96	7.24933	0.33	0.99329	0.69650	0.98287	

Linear Regression: Intercept (b) −0.01350

Slope (K) 0.70917

Coefficient of Determination (r^2) 0.99335

Average γ 0.99596 ± 0.00226

ΔH : 1.82732

Comments: _____

Ed. No. 245 09/81

S-TYPE PITOT TUBE CALIBRATION

PROBE SIZE (ft): 5 | CALIBRATION #: 82-35

PROBE LINER: Glass | DATE: 82-04-19

PROBE MANUFACTURER: RAC | BAROMETRIC PRESSURE (Hg): 29.31

TIP SIZE (inches): 0.373 | AMBIENT TEMP. (°C): 19.4

TIP TYPE: SS | OPERATOR: Kevin Reeve

STACK THERMOCOUPLE: ☒ PRESENT ☐ ABSENT

HP 97 INPUT/OUTPUT

Temp	19.4	°C
Bar. Press	29.31	In. Hg
Scale Factor	0.1	

	0.42	Δ p (std)
Tunnel Velocity	13.755298	ft/sec
	0.74	Δ p (s-pitot)
Cp, at this	0.751487	velocity
Tunnel Velocity	13.758180	(using Cp)

2	1.00	Δ p (std)
	21.224885	
	1.73	Δ p (s-pitot)
	0.752385	
	21.229333	

3	1.94	Δ p (std)
	29.562844	
	3.40	Δ p (s-pitot)
	0.753484	
	29.569040	

4	3.06	Δ p (std)
	37.128385	
	5.38	Δ p (s-pitot)
	0.752285	
	37.136166	

5	4.25	Δ p (std)
	43.756222	
	7.49	Δ p (s-pitot)
	0.751392	
	43.765392	

6	5.16	Δ p (std)
	48.213671	
	9.09	Δ p (s-pitot)
	0.751546	
	48.223775	

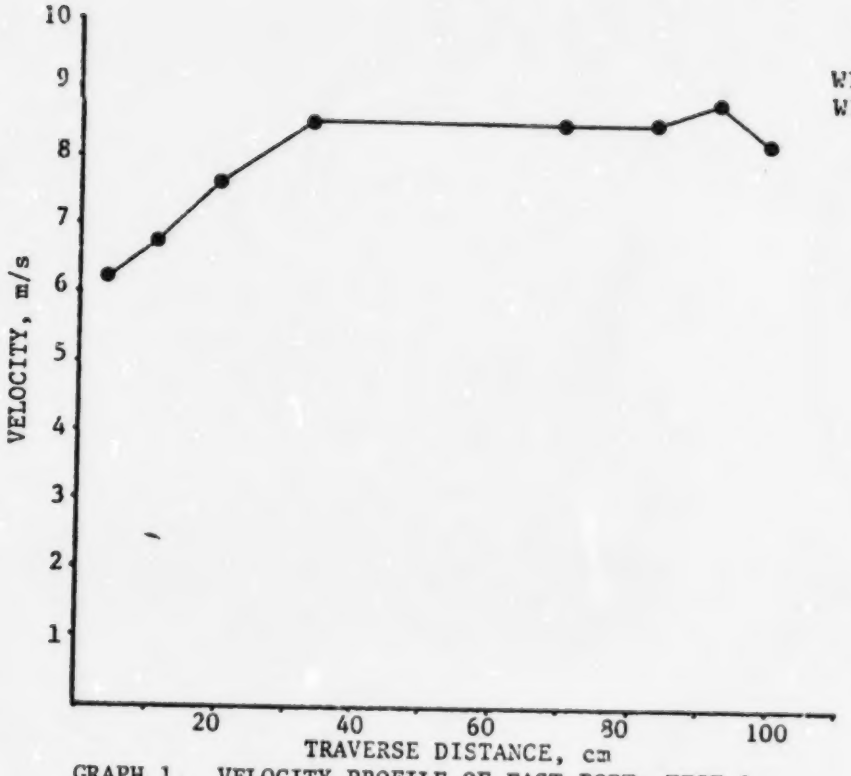
	6.99	Δ p (std)
	56.115642	
	12.30	Δp(s-pitot)
	0.751967	
	56.127402	

	8.09	Δ p (std)
	60.369782	
	14.27	Δp(s-pitot)
	0.751061	
	60.382434	

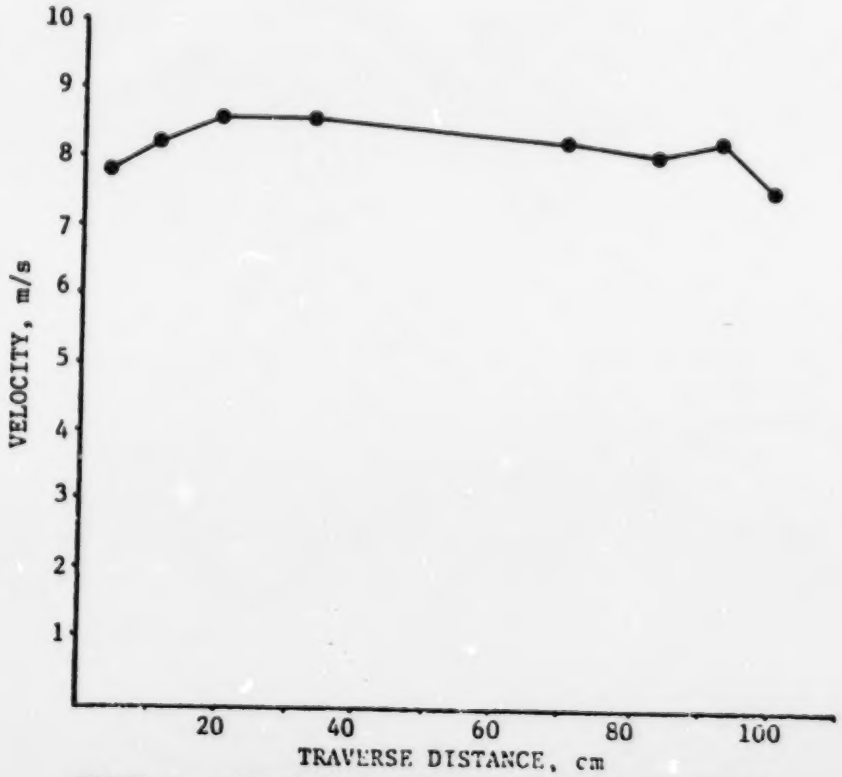
	0.752651	Cp (ave)
	0.002264	Std. Dev.
	8	Deg. of Freedom
	2.306000	t .05
	0.750910	Low Cp
	0.752651	Mean Cp
	0.754392	High Cp

rev. 82-01

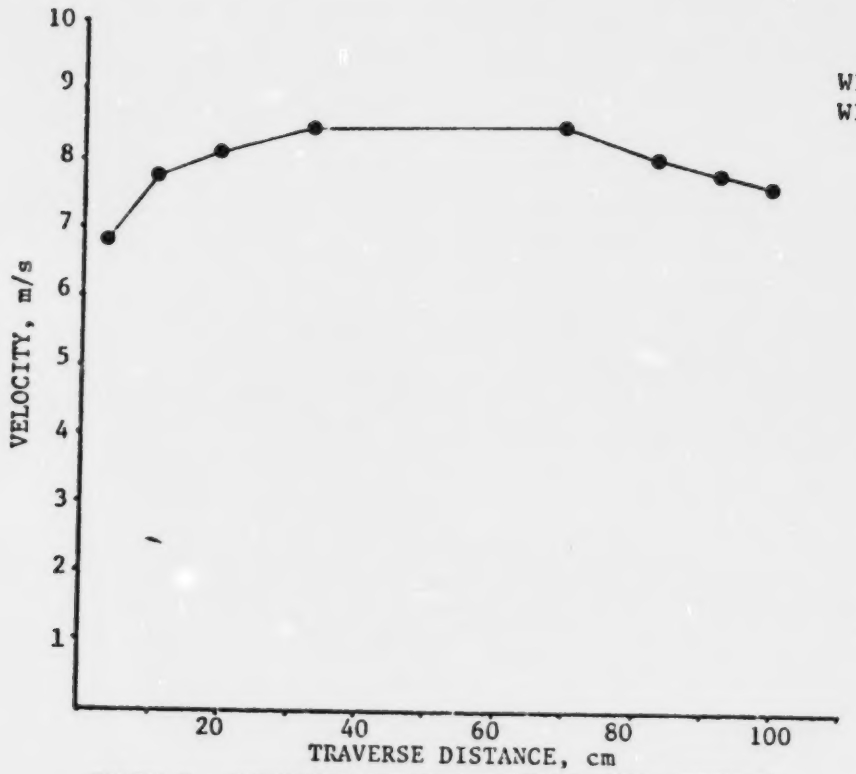
APPENDIX B: VELOCITY PROFILES



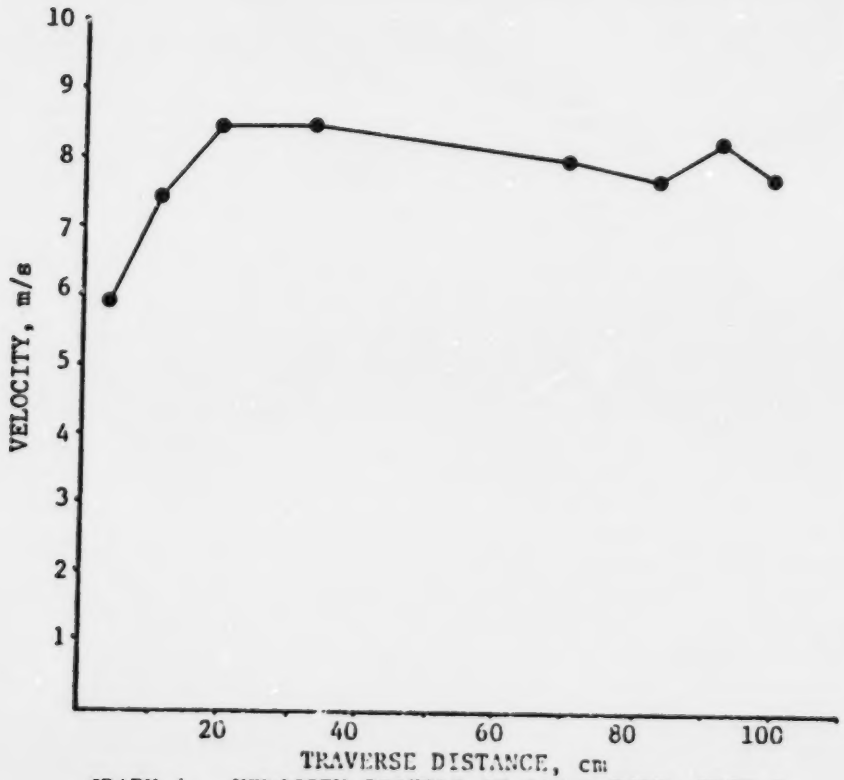
GRAPH 1. VELOCITY PROFILE OF EAST PORT, TEST 1.



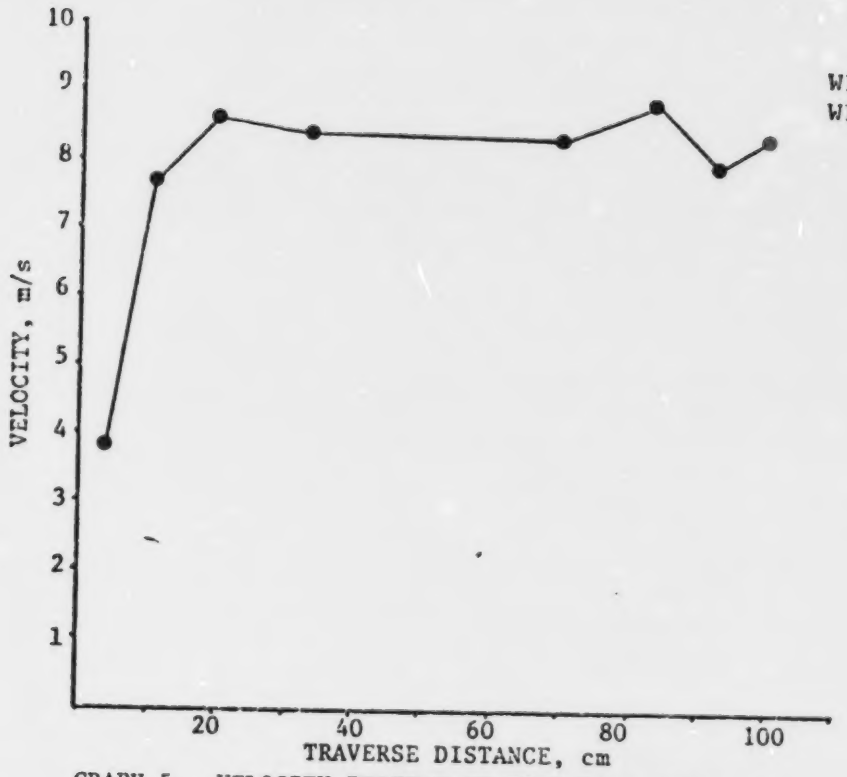
GRAPH 2. VELOCITY PROFILE OF SOUTH PORT, TEST 1.



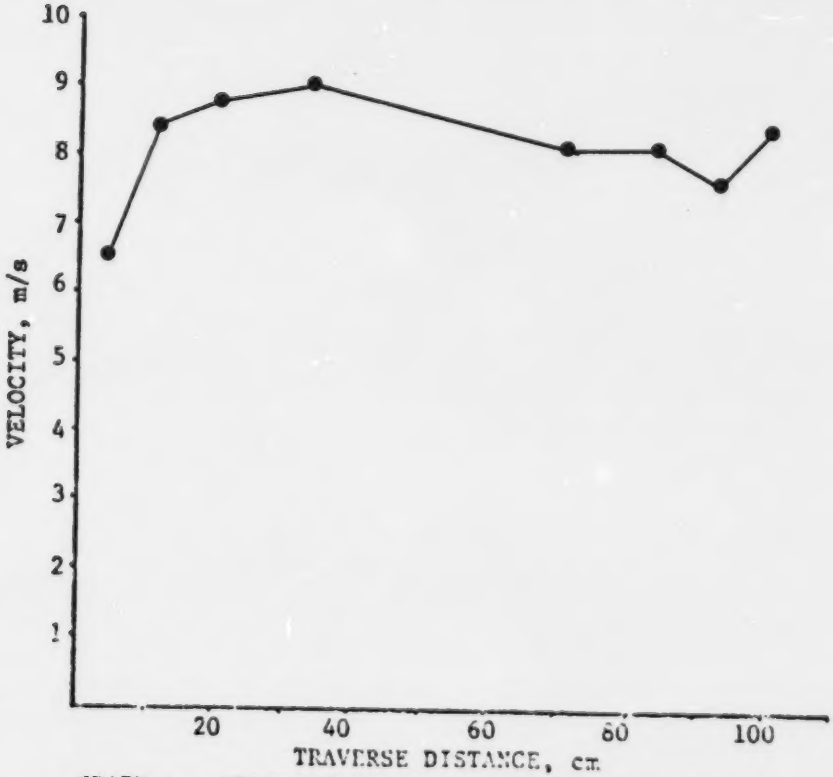
GRAPH 3. VELOCITY PROFILE OF EAST PORT, TEST 2.



GRAPH 4. VELOCITY PROFILE OF SOUTH PORT, TEST 2.



GRAPH 5. VELOCITY PROFILE OF EAST PORT, TEST 3.



GRAPH 6. VELOCITY PROFILE OF SOUTH PORT, TEST 3.

APPENDIX C: FIELD DATA SHEETS

FIELD DATA SHEET

Plant Canada Metal Co. Ltd. Location 1221 St. James Street, Winnipeg

Test number One Date June 1, 1982 Time 10.26 a.m. to 11:51 a.m.

Ambient temperature (°F) 55 Barometric pressure (in. Hg) 29.06 Assumed moisture content 4%

Nozzle diameter 0.373 inch Probe length/type 5 ft./glass Stack static pressure 0.10 " H_2O

Probe temperature 243°F (Ave.) Filter holder temperature _____ Leak check 0.00 CFM @ 15 " Hg Vacuum

Traverse point number	Clock time Start	Stack gas temperature (degrees F)	Gas meter volume cu. ft.	Velocity pressure (in. H_2O)	Orifice pressure drop (in. H_2O)	Gas meter temperature (°F)		Final impinger temperature (degrees F)	Pump vacuum in. Hg	Isokinetic factor, %
						Inlet	Outlet			
East Port 1	0	140	3.891	0.14	1.91	66	55	52	13	98.7
2	5	158	3.957	0.16	1.95	67	55	48	17	95.2
3	10	172	3.952	0.20	1.95	74	57	65	17	85.3
4	15	175	3.922	0.24	1.93	79	58	69	17	76.9
5	20	178	3.916	0.24	1.92	82	59	70	17	76.6
6	25	178	3.943	0.24	1.90	85	60	72	17	77.1
7	30	176	3.934	0.26	1.90	87	62	70	17	73.6
8	35	176	3.905	0.23	1.85	88	64	70	17	77.3
South Port 1	40	175	3.946	0.21	1.92	79	68	55	17	82.1
2	45	174	3.907	0.23	1.90	85	68	56	17	77.1
3	50	175	3.861	0.25	1.82	88	68	57	17	72.8
4	55	178	3.867	0.25	1.82	90	68	58	17	73.1

FIELD DATA SHEET

Plant Canada Metal Co. Ltd. Location _____

Test number One (continued) Date June 1, 1982 Time 10:26 a.m. to 11.51 a.m.

Ambient temperature (°F) _____ Barometric pressure (in. Hg) _____ Assumed moisture content _____

Nozzle diameter _____ Probe length/type _____ Stack static pressure _____

Probe temperature _____ Filter holder temperature _____ Leak check _____ CFM @ _____" Hg Vacuum

	Clock time Start	Stack gas temperature (degrees F)	Gas meter volume cu. ft.	Velocity pressure (in. H_2O)	Orifice pressure drop (in. H_2O)	Gas meter temperature (°F)		Final impinger temperature (degrees F)	Pump vacuum in. Hg	Isokinetic factor, %
						Inlet	Outlet			
5	60	179	3.912	0.23	1.82	92	68	60	17	76.9
6	65	179	3.886	0.22	1.85	92	69	61	17	78.1
7	70	180	3.910	0.23	1.85	92	70	63	17	76.9
8	75	179	3.918	0.19	1.88	93	70	65	17	84.7
Average or total	80 Min.	173	62.627	0.22	1.89	-	-	-	17	80.2

FIELD DATA SHEET

Plant Canada Metal Co. Ltd. Location 1221 St. James Street, Winnipeg

Test number Two Date June 1, 1982 Time 1:52 p.m. to 3:30 p.m.

Ambient temperature (°F) 60 Barometric pressure (in. Hg) 29.06 Assumed moisture content 4%

Nozzle diameter 0.373 Probe length/type 5 feet/glass Stack static pressure 0.10 " H_2O

Probe temperature _____ Filter holder temperature _____ Leak check 0.00 CFM @ 15 " Hg Vacuum

Traverse point number	Clock time (start)	Stack gas temperature (degrees F)	Gas meter volume cu. ft.	Velocity pressure (in. H_2O)	Orifice pressure drop (in. H_2O)	Gas meter temperature (°F)		Final impinger temperature (degrees F)	Pump vacuum in. Hg	Isokinetic factor, %
						Inlet	Outlet			
East Port 1	0	158	4.045	0.16	2.06	72	68	62	17	96.7
2	5	172	3.977	0.20	2.02	79	68	56	17	85.5
3	10	183	3.919	0.22	1.90	84	68	59	17	80.6
4	15	184	3.915	0.24	1.88	86	68	70	17	77.0
5	20	184	3.929	0.24	1.88	89	68	73	17	76.9
6	25	184	3.876	0.21	1.88	92	70	71	17	80.9
7	30	185	3.840	0.20	1.80	93	70	70	17	81.9
8	35	185	3.874	0.19	1.79	95	72	69	17	84.6
South Port 1	40	160	3.772	0.12	1.65	89	75	67	17	101.9
2	45	169	3.976	0.19	1.90	93	75	62	17	107.4
3	50	178	3.950	0.24	1.88	93	75	63	17	76.3
4	55	180	3.963	0.24	1.88	94	75	66	17	76.6

FIELD DATA SHEET

Plant Canada Metal Co. Ltd. Location _____

Test number Two (continued) Date June 1, 1982 Time _____

Ambient temperature (°F) _____ Barometric pressure (in. Hg) _____ Assumed moisture content _____

Nozzle diameter _____ Probe length/type _____ Stack static pressure _____

Probe temperature _____ Filter holder temperature _____ Leak check _____ CFM @ _____" Hg Vacuum

Traverse point number	Clock time (Start)	Stack gas temperature (degrees F)	Gas meter volume cu. ft.	Velocity pressure (in. H_2O)	Orifice pressure drop (in. H_2O)	Gas meter temperature (°F)		Final impinger temperature (degrees F)	Pump vacuum in. Hg	Isokinetic factor, %
						Inlet	Outlet			
5	60	177	3.970	0.21	1.88	95	75	68	17	81.7
6	65	176	3.997	0.20	1.93	96	76	67	17	84.1
7	70	175	3.932	0.23	1.88	97	76	70	17	77.0
8	75	175	3.933	0.20	1.88	98	77	72	17	82.3
Average or total	80	177	62.868	0.21	1.88	-	-	-	17	84.5

FIELD DATA SHEET

Plant Canada Metal Co. Ltd. **Location** 1221 St. James Street, Winnipeg

Test number Three **Date** June 1, 1982 **Time** 4:50 p.m. to 6:16 p.m.

Ambient temperature (°F) 63 **Barometric pressure (in. Hg)** 29.06 **Assumed moisture content** 4%

Nozzle diameter 0.373 **Probe length/type** 5 feet/glass **Stack static pressure** 0.10 " H_2O

Probe temperature _____ **Filter holder temperature** _____ **Leak check** 0.00 CFM @ 15 " Hg Vacuum

Traverse point number		Clock time (Start)	Stack gas temperature (degrees F)	Gas meter volume cu. ft.	Velocity pressure (in. H_2O)	Orifice pressure drop (in. H_2O)	Gas meter temperature (°F)		Final impinger temperature (degrees F)	Pump vacuum in. Hg	Isokinetic factor, %
							Inlet	Outlet			
East Port	1	0	165	2.363	0.05	0.676	79	71	56	6	100.2
	2	5	175	4.111	0.20	2.10	86	71	56	17	88.3
	3	10	184	4.082	0.25	2.05	86	70	53	17	78.9
	4	15	184	4.089	0.24	2.05	80	70	60	17	80.6
	5	20	186	4.087	0.23	2.08	90	70	74	17	82.2
	6	25	187	4.044	0.26	2.03	92	71	70	17	76.3
	7	30	189	4.028	0.25	1.98	93	72	68	17	84.8
	8	35	188	4.070	0.23	1.98	94	72	65	17	81.5
South Port	1	40	168	4.173	0.15	2.08	87	74	64	17	102.5
	2	45	182	4.240	0.24	2.14	91	74	63	17	88.8
	3	50	183	4.153	0.26	2.10	94	75	64	17	77.8
	4	55	180	4.156	0.28	2.10	95	75	64	17	74.8

FIELD DATA SHEET

Plant Canada Metal Co. Ltd. **Location** _____

Test number Three (continued) **Date** June 1, 1982 **Time** _____

Ambient temperature (°F) _____ **Barometric pressure (in. Hg)** _____ **Assumed moisture content** _____

Nozzle diameter _____ **Probe length/type** _____ **Stack static pressure** _____

Probe temperature _____ **Filter holder temperature** _____ **Leak check** _____ CFM @ _____" Hg Vacuum

Traverse point number	Clock time	Stack gas temperature (degrees F)	Gas meter volume cu. ft.	Velocity pressure (in. H_2O)	Orifice pressure drop (in. H_2O)	Gas meter temperature (°F)		Final impinger temperature (degrees F)	Pump vacuum in. Hg	Isokinetic factor, %
						Inlet	Outlet			
5	60	177	4.160	0.23	2.10	96	75	64	17	82.2
6	65	175	4.161	0.23	2.10	97	76	64	17	82.0
7	70	175	4.132	0.20	2.10	97	76	65	17	87.3
8	75	174	4.164	0.24	2.08	97	76	66	17	80.3
Average or total	80	180	64.213	0.22	1.98	-	-	-	16	83.9

APPENDIX D: ANALYTICAL REPORT

Stack Emissions Report Sheet

Report No. 82-165

Plant Canada Metal, Trail #1
Location
Rec'd From K. Reeve
Date Sampled 820601
Date Rec'd 820603

Analysis H_2SO_4 Mist + SO_2
Method # 8
Date Analyzed 820618-22
Analyst G. Robertson D.F.
Report Date 820624

V_{soln} = total sample volume collected, ml.
V_a = sample aliquot titrated, ml.
$\overline{V_t}$ = average volume of barium chloride titrant used per sample aliquot, ml.
$\overline{V_{tb}}$ = average volume of barium chloride titrant used per blank aliquot, ml
Normality of $BaCl_2$ = 0.010 N.

Results:

		Sulphuric Acid Mist				Sulphur Dioxide			
Lab #	I.D.	V_{soln}	V_a	$\overline{V_t}$	$\overline{V_{tb}}$	V_{soln}	V_a	$\overline{V_t}$	$\overline{V_{tb}}$
2446	Bottle #1	250 ml	5.0 ml	60.34 ml	0.01 ml	—	—	—	—
2449	Blank 50% 2-Propanol	—	30.0 ml	0.08 ml	—	—	—	—	—
2247	Bottle #2	—	—	—	—	1000 ml	5.0 ml	117.33 ml	0.06 ml
2248	Blank (3% H_2O_2)	—	—	—	—	—	10.0 ml	0.11 ml	—

Stack Emissions Report Sheet

Report No. 82-162

Plant Cominco Metal TEST #2
Location
Rec'd From K. Reeve
Date Sampled 820601
Date Rec'd 820603

Analysis H_2SO_4 mist + SO_2
Method # 8
Date Analyzed 820618-22
Analyst G. Robertson D.T.
Report Date 820624

V_{soln} = total sample volume collected, ml.
V_a = sample aliquot titrated, ml.
$\overline{V_t}$ = average volume of barium chloride titrant used per sample aliquot, ml.
$\overline{V_{tb}}$ = average volume of barium chloride titrant used per blank aliquot, ml
Normality of $BaCl_2$ = 0.010N.

Results:

Lab #	ID	Sulphuric Acid Mist V_{soln}	Sulphuric Acid Mist V_a	Sulphuric Acid Mist $\overline{V_t}$	Sulphuric Acid Mist $\overline{V_{tb}}$	Sulphur Dioxide V_{soln}	Sulphur Dioxide V_a	Sulphur Dioxide $\overline{V_t}$	Sulphur Dioxide $\overline{V_{tb}}$
2450	Bottle #1	250ml	5.0ml	47.77	0.01	—	—	—	—
2453	3% Blank 2% Preserved	—	30.0ml	0.05	—	—	—	—	—
2451	Bottle #2	—	—	—	—	1000ml	5.0ml	153.76	0.05
2452	Blank (3% H_2O_2)	—	—	—	—	—	10.0ml	0.09ml	—

Stack Emissions Report Sheet

Report No. 82-161

Plant Canada Metal, TEST #3
Location
Rec'd From K. Reeve
Date Sampled 820601
Date Rec'd 820603

Analysis H_2SO_4 mist & SO_2
Method # 8
Date Analyzed 820615-22
Analyst G. Robertson D.F.
Report Date 820624

V_{soln} = total sample volume collected, ml.
V_a = sample aliquot titrated, ml.
$\overline{V_t}$ = average volume of barium chloride titrant used per sample aliquot, ml.
$\overline{V_{tb}}$ = average volume of barium chloride titrant used per blank aliquot, ml
Normality of $BaCl_2$ = 0.010 N.

Results:

Lab #	I.D.	Sulphuric Acid Mist				Sulphur Dioxide			
		V_{soln}	V_a	$\overline{V_t}$	$\overline{V_{tb}}$	V_{soln}	V_a	$\overline{V_t}$	$\overline{V_{tb}}$
12454	Bottle #1	250 ml	5.0 ml	70.29 ml	0.01	—	—	—	—
12457	Blank 40% 2-Propanol	—	30.0 ml	0.07 ml	—	—	—	—	—
12455	Bottle #2	—	—	—	—	1000 ml	5.0 ml	99.27	0.05
12456	Blank (3% H_2O_2)	—	—	—	—	—	10.0 mL	0.10	—